[Embodiment]

Now, an example of the present invention will be described with reference to drawings.

Figure 1 shows an example of a procedure of transmitting a square area of 4 × 4 in an original image as a unit in 16 grades by means of two valued G3 facsimile device.

In Figure 1, at first, a procedure of controlling a receiving side and a sending side is established according to a procedure in G3 facsimile device. A call is set and a line is established in phase A (steps (1), (9)). Phase B is a sequence for confirming states of a terminal or a transmission channel and for controlling a terminal. In phase B, the receiving side is informed that a code indicating gradation determined by the transmission method according to the present invention is used (step (2)). When an acknowledgement from the receiving side is obtained (step (10)), a code indicating gradation is transmitted by message transmission in phase C (step (3)-(7)). After the facsimile message ends, the line is disconnected (step (8)).

In transmitting a facsimile message, the sending side retrieves a square area of 4 × 4 pixels from the original image (step (3)), determines the gradation in the square area based on density of each of 16 pixels (steps (4), (5)), encodes and transmits the gradation (step (6)) as shown in Figure 2. As for an amount of information in a unit pixel block configured with 4 × 4 pixels as a unit, one pixel has either of two types of information as one pixel is white or black. Accordingly, assuming that each pixel is independent and one pixel has information amount of one bit, this unit pixel block of 4 × 4 pixels includes information amount of 16 bits. Therefore, with the above-mentioned dithering method, 16 grades can be represented by using pixel patterns. Then, if a single code is assigned to one of pixel patterns in the above-mentioned dithering method, 16 codes are required and four bits are enough for coding. By directly encoding gradation in this manner, the amount of code to be transmitted is reduced.

On the other hand, when the receiving side recognizes that a code representing gradation is transmitted (step (10)), it reproduces a halftone image by selecting and printing out pixel patterns in the above-mentioned dithering method to represent the gradation according to the gradation represented by the transmitted code the pattern (steps (11), (12)).

As there are multiple types of sets of the above-mentioned pixel patterns for digitizing a halftone image according to the above-mentioned dithering method and each set gives a different quality of pseudo-halftone image, the receiving facsimile device can select the set that most faithfully reproduces the transmitted manuscript in a suitable way. As the transmitted code directly represents a gradation, when the receiving facsimile device has a function of printing out in halftone, the gradation can be printed as it is.

[Advantages of the Invention]

As described above, the transmission method of pseudo-halftone image in a facsimile device of the present invention can transmit a halftone image by higher encoding efficiency than in conventional methods of transmitting by encoding at a pixel level.

Figure 1

#1 (SENDING SIDE)

(1) PHASE A

SET CALL AND ESTABLISH LINE

(2) PHASE B

CONFIRM FUNCTION AND STATE OF TERMINAL

CONFIRM FUNCTION OF TRANSMISSION CHANNEL

(3) RETRIEVE SQUARE OF 4 × 4 FROM ORIGINAL IMAGE

(4) OBTAIN DENSITY OF EACH PIXEL

(5) DETERMINE GRADATION OF SQUARE

(6) SEND CODE REPRESENTING GRADATION

(7) MESSAGE SENT?

(8) DISCONNECT LINE

#2 (RECEIVING SIDE)

(9) PHASE A

ACCEPT CALL

(10) PHASE B

DISPLAY FUNCTION OF TERMINAL AND PREPARE FOR RECEIVING

(11) RECEIVE CODE

(12) RECOGNIZE CODE AND PRINT OUT PIXEL PATTERN OF GRADATION

(15) MESSAGE RECEIVED?

(14) DISCONNECT LINE

Figure 2

#1 (ORIGINAL IMAGE)

#2 PIXEL

#3 (4 × 4 SQUARE AREA)

#4 (SET OF PIXEL PATTERNS)

#5 (DETERMINED GRADATION)

#6 (DIGITIZED IMAGE)

Figure 3

#1 (SENDING SIDE)

(15) RETRIEVE SQUARE AREA OF 4 × 4 FROM ORIGINAL IMAGE

(16) OBTAIN DENSITY OF EACH PIXEL

(17) DETERMINE GRADATION OF SQUARE AREA

(18) REPLACE WITH PIXEL PATTERN REPRESENTING GRADATION

(19) ENCODE AND TRANSMIT IN PIXEL LEVEL

ルで符号化して伝送する従来方法に比べ高い符号化効率で中間調画像を伝送できる。

~~4．図面の簡単な説明~~

~~第1図は本発明に係るファクシミリ装置の擬似中間調画像伝送方法において、原画像の4×4画素の正方領域を一単位として16階調で伝送する場合の手順の一例を示す流れ図、第2図は正方領域の画素パターンによる置き換えを説明する図、第3図は従来のディザ方式の一例を示す流れ図である。~~

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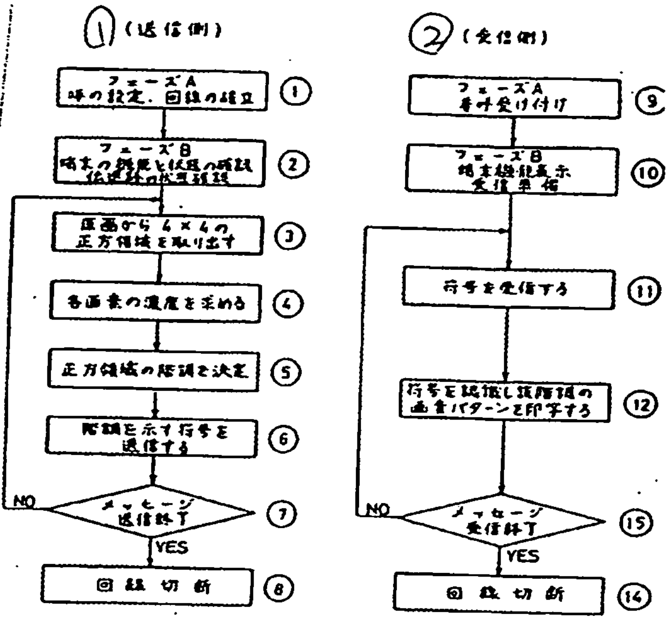
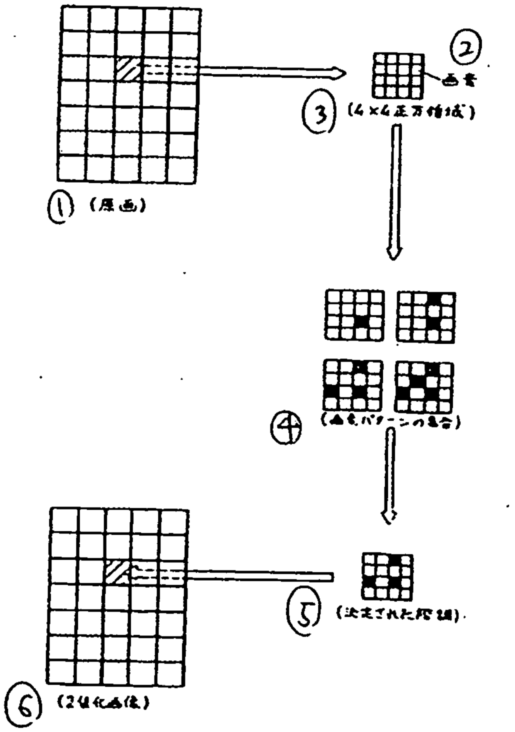
第1図　Fig.1



①（送信側）
②（受信側）
フェーズA 呼の設定、回線の確立
①
フェーズB 端末の機能と状態の確認
②
原画から4×4の正方領域を取り出す
③
各画素の濃度を求める
④
正方領域の階調を決定
⑤
階調を示す符号を送信する
⑥
メッセージ送信終了
⑦
NO
YES
回線切断
⑧
フェーズA 着呼受け付け
⑨
フェーズB 端末機能表示 受信準備
⑩
符号を受信する
⑪
符号を識別し該階調の画素パターンを印字する
⑫
メッセージ受信終了
⑮
NO
YES
回線切断
⑭

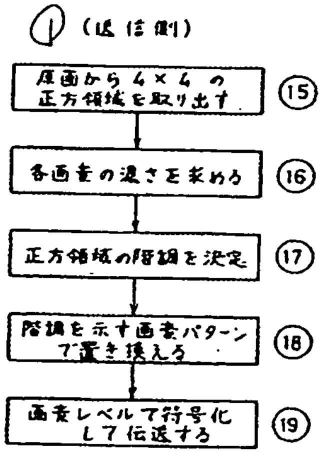
BEST AVAILABLE COPY

第2図　Fig.2



①（原画）
②
画素
③（4×4正方領域）
④（画素パターンの集合）
⑤（決定された階調）
⑥（2値化画像）

第3図　Fig.3



①（送信側）
原画から4×4の正方領域を取り出す
⑮
各画素の濃さを求める
⑯
正方領域の階調を決定
⑰
階調を示す画素パターンで置き換える
⑱
画素レベルで符号化して伝送する
⑲